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ABSTRACT

This paper reports on three separate experiments conducted to examine the roles of particular task and subject characteristics in noun pair learning. In all three studies noun pairs were presented either in noun-verb-noun-conjunction-pronoun (NVNCP) or noun-conjunction-noun-verb-pronoun (NCNVP) contexts. In experiment 1, learning was assessed across three different lists of paired associates in low socioeconomic status (LSES) and middle socioeconomic status (MSES) fifth grade children. Significantly better performance on list 3 was associated with previous practice with NVNCP sentences than with NCNVP sentences for MSES children. In experiment 2, the effects of list length and grade level were assessed within LSES Mexican-American and MSES white populations. MSES subjects recalled more response nouns than LSES subjects in longer lists. A difference in performance associated with sentence type was not detected. In experiment 3, learning was assessed as a function of presentation method and grade level within a MSES white population. Significant age differences were detected with aurally presented materials and with visually presented materials. However, an age difference was not detected with materials presented both aurally and visually. (Author/WR)

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A DEVELOPMENTAL INVESTIGATION OF SENTENCE EFFECTS IN PAIRED-ASSOCIATE LEARNING

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July, 1973

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I would like to express my deep gratitude to the students who have worked with me on various phases of this project. The execution and completion of the studies would not have been possible without their competence and enthusiasm. Significant contributions were made by Leanna Kawate, Steve Kennedy, and James Raines during the initial year in Long Beach, and by Susann Mongrain and John Oldham during the final year in Vancouver.

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Abstract

Three separate experiments were conducted to examine the roles of particular task and subject characteristics in noun-pair learning. In all three studies noun pairs were presented either in noun-verb-noun-conjunction-pronoun (NVNCP) or noun-conjunction-noun-verb-pronoun (NCNVP) contexts.

In Experiment I, learning was assessed across three different lists of paired associates in low socioeconomic status (lo SES) and middle socioeconomic status (mid SES) fifth grade children. Significantly better performance on List III was associated with previous practice with NVNCP sentences than with NCNVP sentences for mid SES children. A similar difference was not observed for lo SES children.

In Experiment II, the effects of List Length and Grade Level were assessed within lo SES Mexican-American and mid SES White populations. A populations difference was detected in the 24 and 36 items lists but not in the 12 items list. Mid SES subjects recalled more response nouns than lo SES subjects in the longer lists. Grades was not significantly related to performance in any of the list lengths for mid SES White students. However, there was a significant age difference in the lo SES Mexican-American on the 36 items list, such that 8th graders performed better than 5th graders. A difference in performance associated with sentence type was not detected.

In Experiment III, learning was assessed as a function of Presentation Method and Grade Level within a mid SES White population. Significant age differences were detected with aurally presented materials, i.e., 11th graders learned more rapidly than 8th graders, who in turn learned more rapidly than 5th graders; and, with visually presented materials, i.e., 8th graders learned more rapidly than 5th graders. However, an age difference was not detected with materials presented both aurally and visually. A difference in performance associated with sentence type was not detected.

Sentential Effects in Multiple-List Noun-Pair Learning

Nancy S. Suzuki and Leanna Kawate

In recent years, a number of investigators have examined the utility of linguistic constructs in interpreting the phenomenon of sentence facilitation in paired-associate learning (Davidson & Dollinger, 1969; Suzuki & Rohwer, 1968, 1969; Ehri, 1972; Suzuki, 1972). Although some differences exist among the various investigators in the specific characterizations of deep structure (i.e., Davidson & Dollinger and Suzuki & Rohwer argue for underlying subject-object relations while Ehri argues for deep structure case relations) the studies support the interpretation that deep structure relations rather than surface structure determine the manner in which noun pairs are stored in memory.

More specifically, the argument is that noun pairs occurring in the same underlying kernel unit are learned more readily than noun pairs occurring in separate underlying units. Whereas in the former type of sentence relations are aroused between the two nouns, such as subject-object relations, relations between the two nouns are not aroused in the latter. This distinction can best be illustrated in the following sentences,

V: The jail trapped the gorilla and him.

C: The jail and the gorilla trapped him.

The prediction is that the noun pair, "jail-gorilla" would be learned faster in sentence type V than in sentence type C. The results of studies with fifth and sixth grade middle class children are consistent with this prediction.

In all of the above mentioned studies performance was examined on a single list of items. An interesting empirical question that is raised is whether or not the sentence effect would be maintained over successive lists of paired associates. General learning-to-learn procedures have been used previously in facilitation studies (Rohwer, Ammon, Suzuki and Levin, 1971; Kee and Rohwer, in press), however, differences in materials and procedural matters limit the kinds of predictions that can be made for C and V sentences. It may be that sentence type has an effect on performance initially but the effect is reduced with additional lists of paired items. Alternatively, the sentence effect may be more pronounced with additional practice on the task. In studies unrelated to the underlying structure question Postman and Schwartz (1964) found that paired-associate test performance was significantly better for subjects who had previous practice on a paired-associate task than for subjects who had practice on a serial learning task. However, there were virtually no practice effects when the criterion test was a serial learning task. The present study was designed to examine the additional

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variable of test type in multiple-list p-a learning by manipulating factorially sentence contexts for practice lists, C vs. V, and sentence contexts for test list, C vs. V.

Another purpose of the experiment was to examine the effects of the experimental variables in a sample of lower class children. Previously, the studies examining the underlying structure hypothesis were conducted with children from middle socioeconomic (SES) backgrounds. Although population differences have been examined extensively by Rohwer and his collaborators (Jensen and Rohwer, 1970; Rohwer and Ammon, 1971) C and V sentences have been used only in an unpublished study by the principal investigator. Thirty-two low SES and 32 middle SES fifth graders participated in the study and were presented with 24 pairs of nouns. The nouns were presented in either a C (NCNVP) or V (NVNCP) sentence. The results are presented in Figure 1 as a function of Populations and Sentence Type. An inspection of the

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Insert Figure 1 about here

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figure reveals that the populations did not differ in total learning scores. However, a significant sentence type by trials interaction was detected within populations such that V sentences promoted better learning than C sentences quite early in learning for mid SES children but not until later for lo SES children. The present experiment was designed to attempt to replicate the finding of no population difference and further examine the differential learning curves for the different sentences.

In sum, the purpose of the present study was first, to examine the effects of practice type and test type in multiple-list learning, and second, to determine whether or not equivalent effects would be obtained in children from lower and middle class backgrounds.

Method

Materials. The learning materials consisted of three different lists of 24 noun pairs. The nouns were presented either in a noun-conjunction-noun-verb-pronoun (C) sentence or a noun-verb-noun-conjunction-pronoun (V) sentence. The experimental conditions were distinguished by the type of sentences presented during the two practice lists and the type of sentence presented during the test list. The factorial combination of practice, CC and VV, and the two types of test lists, C and V, resulted in four experimental conditions. The order of list presentation was completely counterbalanced such that two subjects in each of the experimental conditions were assigned to one of the six different list orders.

Design. The design was a 2 x 2 x 2 x 2 factorial with principal factors of Population (mid SES vs. lo SES); Practice within populations (CC vs. VV); Test within populations (C vs. V); and Grade within populations (fifth vs. sixth grade). Two sets of analyses were

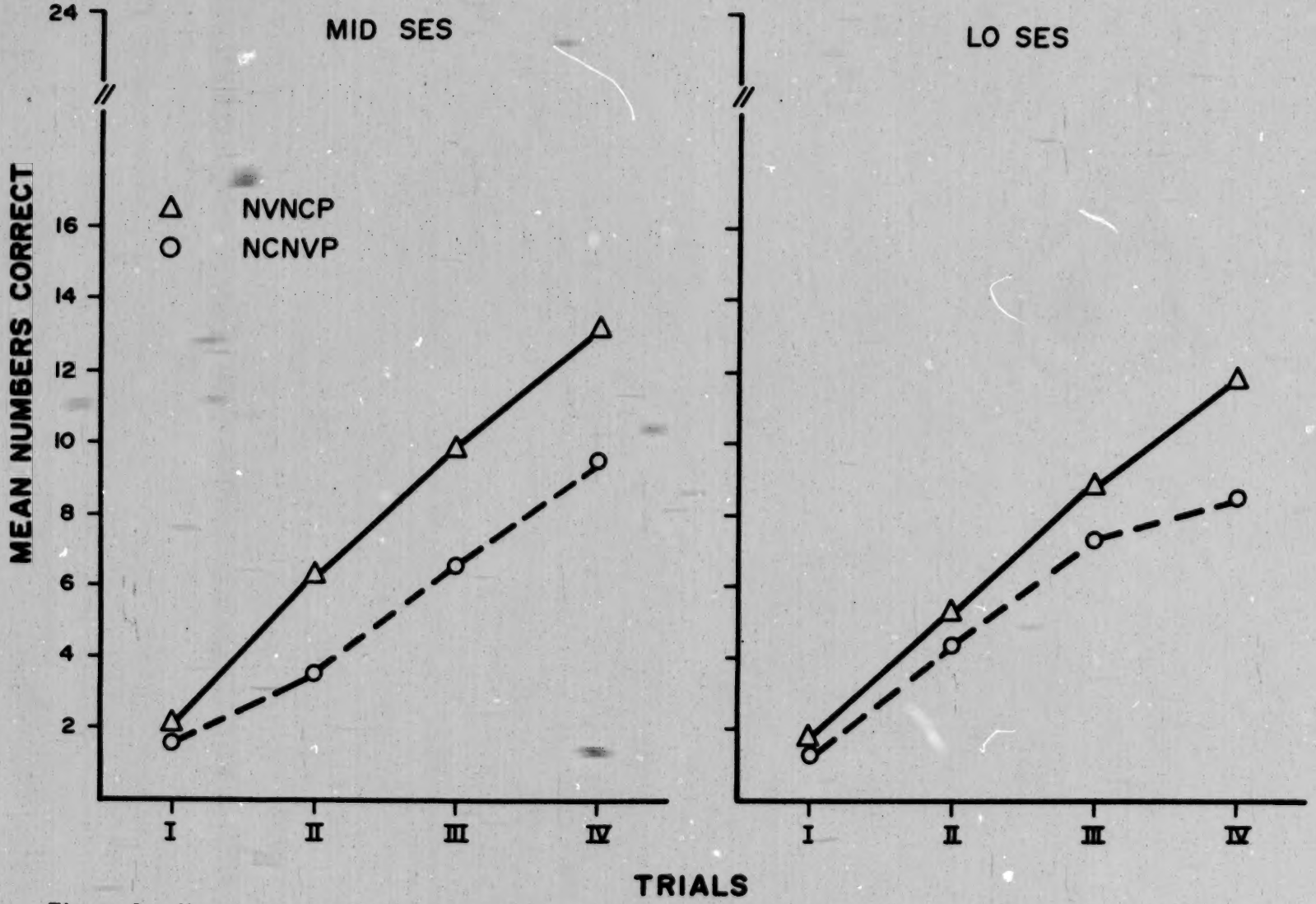

Figure 1. Mean numbers of correct responses per trial as a function of Populations and Sentence Type.

performed on the data. Performance on the practice lists was analyzed in the first by multivariate analysis of variance. The second analysis was performed on the data from the test list by a univariate analysis of variance procedure. Since there were only two dependent measures in the test list analysis, i.e., two trial scores, either a mixed model univariate analysis (Winer, 1962) or a multivariate repeated measures analysis (Morrison, 1967) would have been appropriate.

Subjects. A total of ninety six subjects participated in the present study. Forty eight students from each of two schools were randomly assigned to the different experimental conditions. One school served a middle class residential area as determined by census tract information such as median income, median education, and median occupation. The other school served a lower class residential area as determined by the same census tract indices. Fifty per cent of the students from the lo SES school participating in the study had Spanish surnames. Equal numbers of fifth and sixth grade students participated from each school.

Procedure. The task was administered by an Oriental female experimenter. A study-test method was used for a total of 6 trials, 2 trials per list. All three lists were administered in one sitting. Subjects were asked to listen to the sentences on the tape recorder and attempt to remember the two nouns from each sentence such that when one of the nouns from a sentence was presented they would be able to supply the missing noun. Four example items were presented and repeated until subjects recalled three out of four correctly.

All of the items were presented on an auditory tape recorder at a 4-sec. rate. The intertrial interval was 4-sec, and the interlist interval was approximately 15-sec. during which time the experimenter changed the casette tapes.

Following the learning task the Peabody Picture Vocabulary Test (Form B) was administered to each student. The test was administered according to the instructions in the manual.

Results

The mean numbers of correct responses per trial are presented in Figure 2 as a function of Populations, Practice and List. As mentioned in the Methods section, two separate analyses were performed

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Insert Figure 2 about here

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on the data. Performance on the practice lists was analyzed first by a multivariate analysis of variance procedure. Test list performance was examined in the second analysis by a univariate analysis of variance. The between subjects sources of variance were tested with the probability of a Type I error at .05, while the

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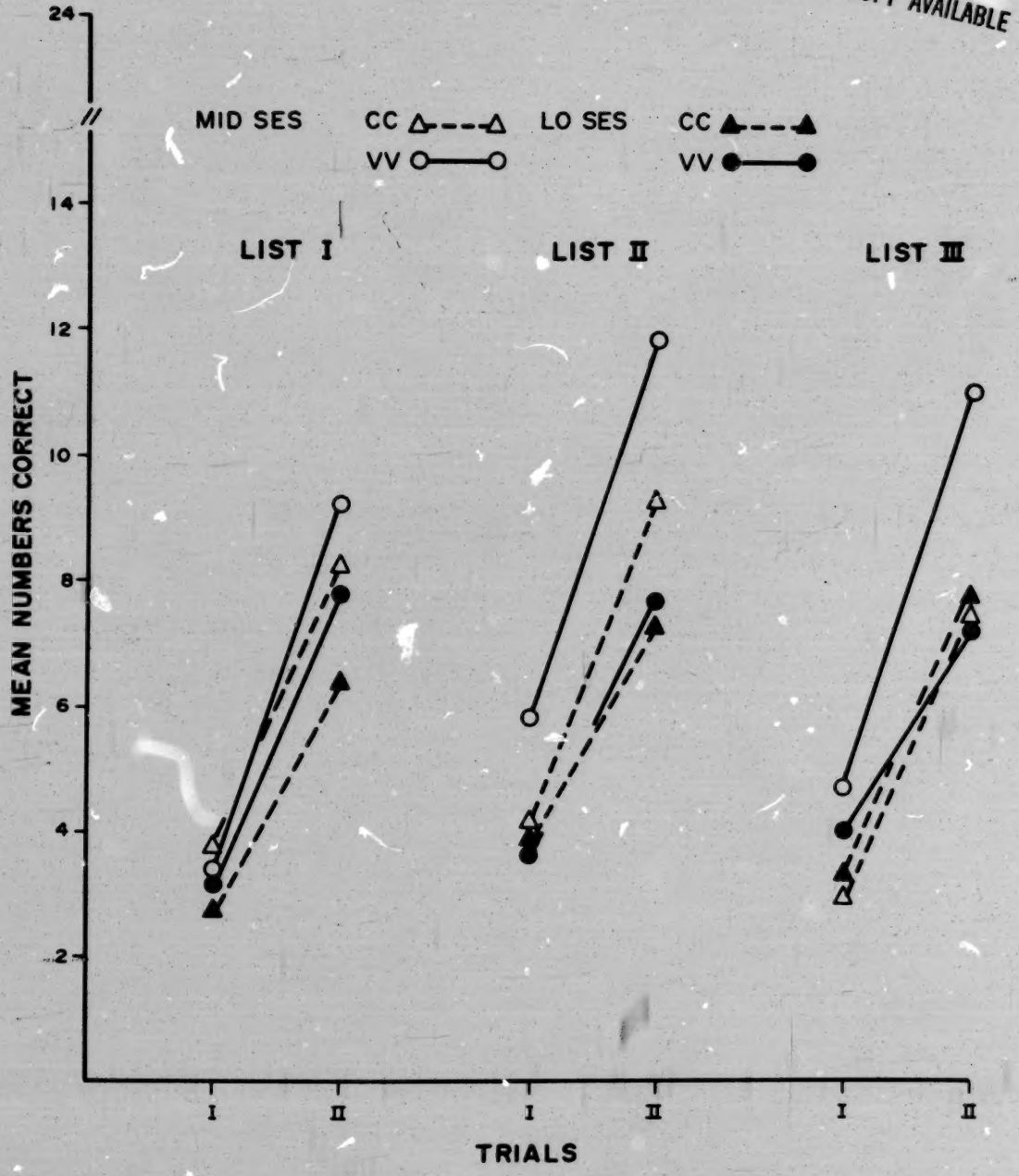

Figure 2. Mean numbers of correct responses per trial as a function of Populations, Practice, and Lists.

within subjects multivariate and univariate tests were performed with the probability of a Type I error at .01.

Practice. The dependent measure for the between subjects analysis was the total learning score across 2 lists and 2 trials. The Populations effect was significant, $F(1,80)=4.86$. The mid SES children recalled more correct response nouns than the lo SES children, 27.84 and 21.52, respectively. This result is contrary to the finding in the previously unreported study with single-list learning. Grades within Populations was also significant, $F(2,80)=3.13$, with fifth grade students recalling an average of 28.24 items and sixth grade students recalling an average of 21.12 response nouns correctly. This grade difference was unexpected and the source of it remains indeterminate. None of the interactions involving Grades was significant. The effect of Practice was not significant in either the mid SES, $F(1,80)=1.42$, or the lo SES, $F(1,80)=<1$. The effect of Test was also examined in this analysis to assess possible differences between groups having identical practice lists but different test lists. Test was not significant in either population, mid SES, $F(1,80)= 2.85$; lo SES, $F(1,80)=<1$.

For the within subjects portion of the analysis, three new orthogonal transformations were created from the original four dependent measures. The three new variates provided for an examination of Trial effects, List effects, and Trial x List interactions. The overall effect of Trials was signficant, $F(1,80)=254.40$. Lists was also significant, $F(1,80)=19.21$, indicating a general practice effect for all subjects. The multivariate test for Populations was not significant, $F(4,77)=2.30$, however, the univariate test for Trials was, $F(1,80)=6.74$, such that mid SES children gained significantly more from Trial 1 to Trial 2 than lo SES children, $\bar{X}$s = 4.26 to 9.66 and 3.44 to 7.32, respectively. Neither of the multivariate tests for Practice within populations was significant, mid SES, $F(4,77)= 2.25$; lo SES, F, $(4,77)=<1$. However, the univariate test on Lists did approach significance for the mid SES children, $F(1,80)=6.03$, $p=<.016$. The means were in the direction favoring the VV group with a larger increase from List 1 to List 2 than the CC group, from 6.29 to 8.83 and from 5.98 to 6.73, respectively. None of the other terms was significant in the analysis.

Test. The dependent variable for this analysis was the number of correct responses on the test list across 2 trials. Populations was not significant, $F(1,80)=1.29$. This result is not consistent with the findings from the practice lists, which indicated that mid SES children recalled more correct response nouns than lo SES children. An inspection of Figure 1 suggests a drop in performance for the mid SES children contributing to this result. Grades within populations was not significant, $F(1,80)=1.26$, also contrary to practice performance. Practice was significant for mid SES children, $F(1,80)=5.24$, but not for lo SES children, $F(1,80)=<1$. For mid SES children practice with V sentences during List I and List II promoted better learning in List III than practice with C sentences. The effect of Test type was not significant in either population, mid SES, $F(1,80)= 1.67$; lo SES, $F<1$. The interaction of Practice and Test

was not significant in either population. Consistency between practice and test contexts was therefore not related to performance. The results indicate that for mid SES children type of practice regardless of type of test influenced performance. Trials was significant in both populations. None of the other terms in the analysis was significant.

Difference scores between practice and test performance are presented in Table 1 as a function of Populations and Practice-Test Conditions. In an analysis supplementary to the main analyses of

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Insert Table 1 about here

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the study, it was found that the difference scores were significantly different among the experimental conditions in the mid SES children, $F(1,80) = 6.32$, $p = <.01$, but not in the lo SES children, $F(1,80) = 4.21$, $p = >.01$. An inspection of the scores suggests that in the mid SES children the loss in items from practice to test was greater for CCV than for VVC and VVV groups. The VVV group was the only one that gained on the test list. It is interesting to note that for lo SES children, the two consistent conditions, CCC and VVV were associated with positive difference scores (gains) while the other two conditions were associated with negative scores. More interestingly, the average difference score for the lo SES children was +.23 while the corresponding score for the mid SES children was -.34.

Correlation coefficients were computed between Peabody raw scores and learning scores. Since there were no consistent patterns to these correlations, the coefficients are presented in Appendix A rather than in the body of this paper.

Discussion

The results of the final list performance in the present study are consistent with the previous finding of an absence of population differences in noun-pair learning. However, the present results suggest that different variables contributed to the final equivalence in performance in the two populations. Sentence type during practice was significantly related to performance for mid SES children. V sentences were associated with better recall than C sentences, the difference approached significance in List II and was significant in List III. Regardless of the context of List III pairs, children who had previous practice with V sentences outperformed children who had previous practice with C sentences. These results suggest that practice in processing sentences in which nouns are related in underlying units allowed subjects to become proficient at processing more difficult sentences and storing the information for more effective retrieval. On the other hand, practice in processing sentences in which nouns are not related in underlying units was not beneficial to subjects for utilizing V sentences appropriately.

Table 1

Average Difference Scores Between

Practice and Test as a Function of

Populations and Practice-Test Conditions

Mid SES

Conditions	List I + II/2	List III	Difference
CCC	4.99	4.96	- .03
CCV	7.70	5.54	-2.16
VVC	7.21	6.67	- .54
VVV	7.84	9.00	+1.16

Lo SES

Conditions	List I + II/2	List III	Difference
CCC	4.56	6.17	+1.61
CCV	5.59	5.04	- .55
VVC	5.86	5.38	- .48
VVV	5.52	5.96	+ .44

Sentence type was not signficantly related to performance in lo SES children. Although not significant what appears to be more critical than sentence type for these children in determining final performance is consistency between practice and test sentences. The means for the consistent conditions were, CCC=6.17 and VVV=5.96, while the means for the other two conditions were, CCV=5.04 and VVC=5.38. The net result of the significant effect of practice sentences in mid SES children and the absence of a similar effect in lo SES children was a reduction of the overall populations difference detected in the initial lists. The average gain score for mid SES children from practice to test was -.34 while the average gain score for lo SES children was +.23.

It would be pure speculation to attempt to interpret these population differences here. One comment, however, is in order concerning the absence of a sentence effect in lo SES children. Recall that in the study reported in the introduction sentence type was associated with performance only on the last trial. It was not clear from those results whether the late emergence of the sentence effect was related to task familiarity or material familiarity, that is, whether the difference on trial 4 was due to practice over three trials with a paired associate task or practice with the specific items. The present study indirectly rules out task familiarity as a possible explanation since the children had a total of six learning trials with a paired associate task, and the sentence effect was not detected. The question is open for investigation then as to whether or not more extensive practice with the same set of materials would result in a significant sentence effect.

List Length, Population, and Grade Level[1] in Noun-Pair Learning

Nancy S. Suzuki and James M. Raines

The sentence facilitation effect in paired-associate learning has been well documented in recent years (see for example, Rohwer, 1967; Bobrow & Bower, 1969; Reese, 1970; Paivio, 1971). In its most general form the phenomenon may be described as follows; noun pairs are learned more efficiently in noun-verb-noun sequences than in noun-conjunction-noun sequences. The pair, MOUSE-WITCH, is thus learned much faster in the context, "The mouse scared the witch", than in the context, "The mouse and the witch". Modifications of these noun-conjunction-noun sequences have permitted the use of linguistic constructs in interpreting the sentence facilitation phenomenon (see Introduction in Experiment I of this report).

Children from middle class backgrounds (mid SES) learn noun pairs in modified contexts, such as sentences of the form, noun-verb-noun-conjunction-pronoun (NVNCP) more rapidly than in noun-conjunction-noun-verb pronoun (NCNVP) sentences (Suzuki & Rohwer, 1969; Suzuki, 1972). However, children from lower class backgrounds (lo SES) learn noun pairs equally well in NCNVP and NVNCP sentences (see Experiment I). Rather than attempt to explain the differential effectiveness of sentence type across populations in terms of storage and retrieval processes, a more fruitful approach, at least until there is further replication of the difference, seemed to be to examine specific task and subject characteristics in relation to sentence type within the two populations.

Two potentially influential task variables are suggested by the ever increasing literature examining the nature of the facilitation effect in mid SES white children. Levin, Horvitz and Kaplan (1971)for example, found that the manner in which materials are presented to subjects is related to whether or not a facilitation effect is detected. That is, when verbal contexts were presented in printed form and read to subjects, facilitation of verb contexts over conjunction contexts was not observed. However, when only the nouns were presented in printed form and the context read to subjects, a difference was observed between the two context conditions. The importance of the task characteristic of presentation method was used to explain some of the other failures to replicate the sentence facilitation phenomenon, i.e., studies by Yuille and Pritchard (1969) and Davidson, Schwenn and Adams (1970). The explanation is not sufficient, however, in handling the results of other studies. Ehri and Rohwer (1969) and Suzuki and Rohwer (1969), for example, used the combination aural and visual presentation method and observed significant differences in

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[1] We wish to thank Stephen Kennedy for his invaluable assistance in the preparation of the materials.

performance associated with the two types of contexts. Upon closer examination it was found that the studies varied in yet another task characteristic, that of list length. Levin, Horvitz and Kaplan (1971) and Davidson, Schwenn and Adams (1970) used 12 items lists; Yuille and Pritchard (1969) used a 16 items list; Ehri and Rohwer (1969) used a 20 items list; and Suzuki and Rohwer (1969) used a 24 items list. The present study was designed to assess systematically the effect of this variable on performance by manipulating the number of items presented in a list and holding constant the method of presentation. In addition, the effect of the variable was examined within lo SES and mid SES populations.

Another purpose of the present experiment was to assess the subject characteristic of grade level. All of the above mentioned studies were conducted with elementary school children, primarily fifth grade students. Recently, Bean and Rohwer (1970) found significant differences in the effectiveness of experimental manipulations between the performance of preadolescent and adolescent students on a 36 items list. More specifically, they found that presenting noun pairs in sentence contexts promoted learning relative to a control condition in preadolescent but not in adolescent subjects. It was of interest to examine the effect of age, within the adolescent range, on the learning of noun pairs in two different sentence contexts. In sum, the purpose of the present experiment was to determine whether or not equivalent list length and age effects would be obtained in lo SES and mid SES populations.

Method

Materials. The learning materials consisted of pairs of high frequency nouns. List length was determined in the following manner. Two different lists of 36 noun pairs were first constructed. From this list of 36 items, 24 items were randomly selected for the 24-items condition. From the list of 24 items 12 were randomly selected for the 12-items condition. In all three list length conditions two different lists of paired nouns were used. The sentence conditions were distinguished by the context for the noun pairs. Thus, nouns were presented in noun-conjunction-noun-verb-pronoun contexts for NCNVP sentences and noun-verb-noun-conjunction-pronoun contexts for NVNCP sentences. Sentence type was manipulated by a mixed list method in the present experiment(Levin, Horvitz and Kaplan (1971) found identical results with mixed list and independent groups designs). Counterbalancing of sentence type to item assignment resulted in two different Item Sets.

Design. The design included three separate 2 x 3 factorials for the three different List Lengths of 12 items, 24 items, and 36 items. The principal factors were Populations (lo SES Mexican-American vs. mid SES white) and Grades (5th vs. 8th vs. 11th grade), and secondary factors were List (A vs. B) and Item Set (I vs. II). Within subjects variables were Sentence Type (NCNVP vs. NVNCP) and Trials (1 - 6). The within subjects variables were assessed by means of a multivariate analysis of variance.

Subjects. Two hundred and sixteen subjects from public schools in Los Angeles and Orange counties participated in the present study. One hundred and eight white students from public schools serving a middle SES residential area and 108 Spanish-surnamed students from public schools serving a low SES residential area were assigned to the experimental conditions. SES was determined by census tract information on indices of income, education, and occupation.

Whereas 50% of the lo SES students were Mexican-American in Experiment I, all of the lo SES students in the present study were Mexican-American. Recent studies have failed to detect ethnicity differences in young children's learning (Kee and Rohwer, in press) and adolescent learning (Kennedy and Suzuki, manuscript in preparation), when social class is controlled. Nevertheless, it was felt that a developmental investigation of the minority ethnic group could be quite informative.

Procedure. The task was administered by a white male experimenter. A study-test method was used for a total of 6 learning trials. Subjects were asked to listen to the sentences on the tape and attempt to memorize the pairs of nouns from each sentence such that when later presented with one of the nouns from a sentence they could recall the missing noun from that sentence. Four example items were presented and repeated until subjects recalled 3 out of 4 correctly.

The materials were presented on an auditory tape recorder. Sentences were presented at a 4-sec rate during study and test trials. The intertrial interval was 4-sec. Following the learning task subjects were presented with the Peabody Picture Vocabulary Test (Form B). Instructions and administration of the test were in accord with the Examiner's Manual.

Results

The mean number of correct responses are presented in Table 2 as a function of list length, Populations, Grades, and Sentence Type.

Insert Table 2 about here

Three separate analyses were performed on the data, one for each List Length. The analyses were identical across List Lengths. The original 12 dependent measures resulting from the 2 Sentence Type and 6 Trial scores were transformed into 11 orthogonal variates for the multivariate analysis of variance. The variates were created to permit assessment of Sentence Type, trends across the 6 Trials, and interactions between Sentence Type and Trials. Between sources of variance were tested with the probability of a Type I error at .05, while multivariate and univariate tests on within sources of variance were tested at .01. The factor of grades was examined in 2 nonorthogonal contrasts throughout the analysis, Grade 5 vs. Grade 8 and Grade 8 vs. Grade 11. All effects were nested within Populations.

Table 2

Mean Numbers of Correct Responses per Trial as a Function of List Length, Sentence Type, Populations, and Grades

		12 Items		24 Items		36 Items	
		NCNVP	NVNCP	NCNVP	NVNCP	NCNVP	NVNCP
Lo SES Mexican-American	Grade 5	2.83	2.50	4.11	4.51	4.43	5.03
	Grade 8	3.49	3.01	6.25	5.24	7.49	6.85
	Grade 11	3.60	3.72	5.69	5.04	8.53	8.58
Mid SES White	Grade 5	3.32	2.96	5.79	5.15	7.17	6.04
	Grade 8	3.14	3.25	6.25	6.38	8.68	8.10
	Grade 11	3.67	3.50	7.26	7.60	9.21	9.32

Note.--Maximum possible = 6 for 12 Items, 12 for 24 Items, 18 for 36 Items.

12-items list. The dependent variable for the between subjects sources of variance was the total number of responses across Sentence Type and Trials. Populations was not significant in the 12-items List, $F(1,48) = < 1$. Lo SES Mexican American students recalled just as many response nouns correctly as mid SES white students. The effect of Grades within Populations was also not significant, $F(4,48) = 1.23$, such that there was an equivalence in performance among 5th graders, 8th graders, and 11th graders. None of the other terms in the analysis of between subjects sources of variance was significant.

In the within subjects sources of variance analysis the overall Sentence effect was not significant, $F(1,48) = 3.33$. A reliable difference was not observed in performance as a function of Sentence Type. Mean numbers of correct responses per trial collapsed across Sentence Type are presented in Figure 3 as a function of Populations and Grades. None of the multivariate tests was significant in the

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Insert Figure 3 about here[2]

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except Lists x Item Set within Populations, $F(24,74) = 2.69$. The effect appeared to be located primarily in the lo SES Mexican-American students, $F(12,37) = 4.21$; the univariate test for Sentence Type was significant, $F(1,48) = 11.32$, and so was the Sentence Type x Cubic trend interaction, $F(1,48) = 7.57$. An inspection of the means suggested that some items were easier to learn than others regardless of Item Set, that is, regardless of the context it was presented in. The source of the Sentence Type x Cubic trend interaction remains indeterminate.

Although the multivariate test for Grades within Populations was not significant, $F(48,145) = 1.35$, the univariate test for Sentence Type x Cubic trend was significant for the Grade 8 vs. Grade 11 contrast in mid SES white students, $F(1,48) = 8.71$. An inspection of the appropriate learning curves revealed that there was a deflection between Trials 3 and 4 for NCNVP sentences in Grade 8 students. The explanation for this finding remains indeterminate.

24-items list. The main effect of Populations was significant in the 24-items List, $F(1,48) = 5.83$. Mid SES White students produced a larger number of correct responses than lo SES Mexican-American students, 76.80 and 61.68, respectively. The effect of Grades within Populations, however, was not significant, $F(4,48) = 1.84$. None of the other terms in the analysis was significant.

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[2]Note.--Population labels in Figures 3, 4, and 5 should read Lo SES Mexican-American and mid SES White.

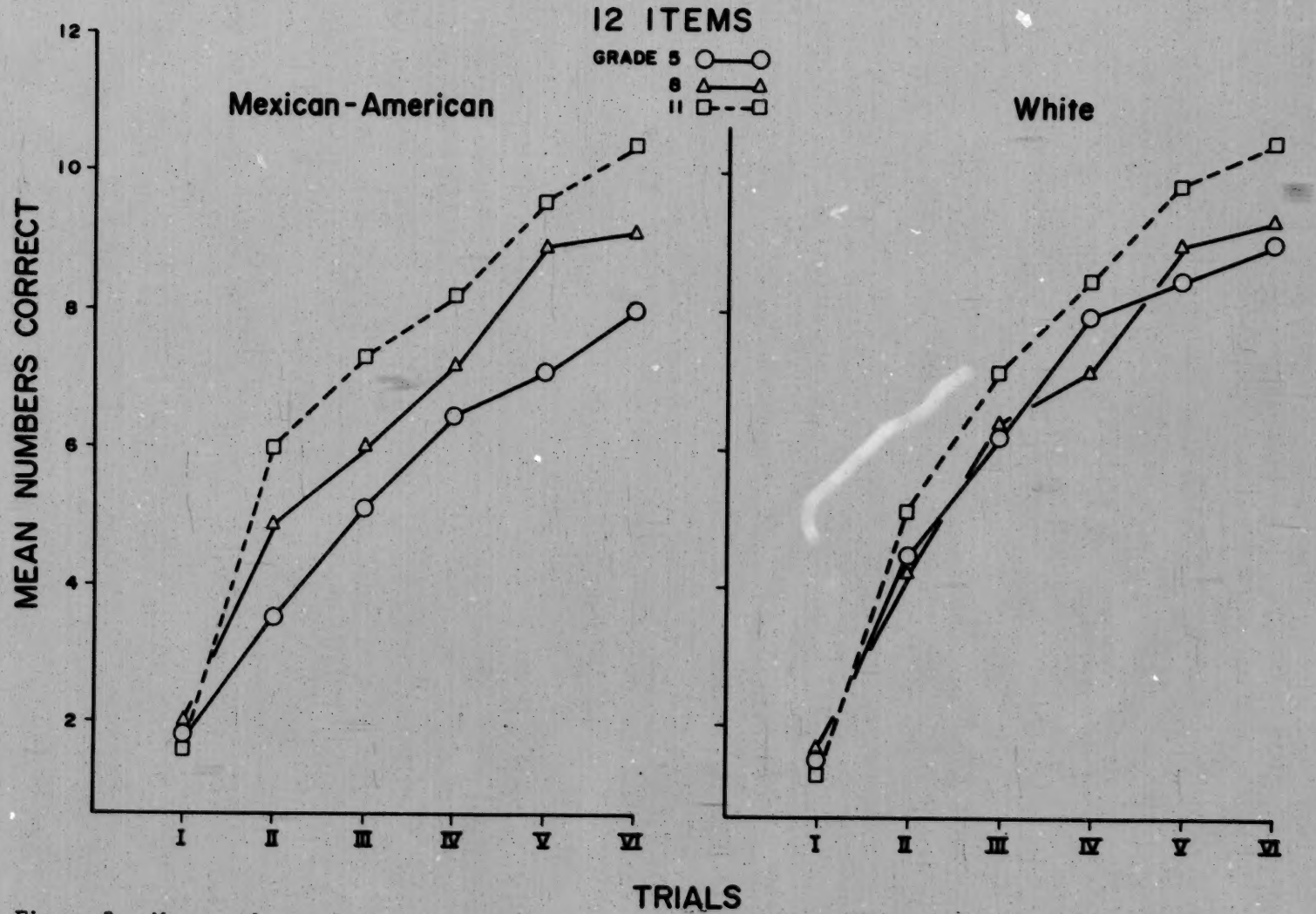

Figure 3. Mean numbers of correct responses per trial as a function of Populations and Grades.

In the analysis of within subjects sources of variance, the effect of Sentence Type was not significant, F (1,48) = 2.27. Furthermore, the sentence effect was not detected in the Grade 5,mid SES White children. This finding is contrary to expectation, particularly since this List Length-Population subgroup represented the group most similar to subjects in the previous studies (Suzuki, 1972; Experiment I in this report). The only difference across studies was a procedural one. Sentence Type was manipulated by means of independent groups in the previous studies but by means of a mixed list method in the present study. It is possible that in a mixed list presentation the beneficial effects of NVNCP sentences increase performance associated with NCNVP sentences. Supporting this argument is the finding in the present analyis of equivalence in performance among the three grade levels, that is, fifth grade students recalled as many response nouns as eleventh grade students. However, an examination of the appropriate data reveals that the means are in the opposite direction, NCNVP= 4.5 and NVNCP= 3.5. The comparable means in the previous study, NCNVP= 3.3 and NVNCP = 4.4. It would be inappropriate, therefore, to attempt to explain this finding within the context of the present experiment.

None of the multivariate tests was significant, however, the univariate test for Sentence Type was significant for the Grade 5 vs. Grade 8 contrast within the lo SES Mexican-American students, F (1,48) = 6.64. An examination of the appropriate means in Table 1 reveals that the sentence difference was greater for Grade 8 students than Grade 5 students, and additionally, NCNVP was associated with better performance than NVNCP sentences. Figure 4 displays performance on the 24-items List as a function of Populations, Grades, and Trials.

Insert Figure 4 about here

36-items list. The main effect of Populations was significant in the 36-items List, F (1,48) = 4.18, as in the 24-items List. Mid SES White students recalled more correct response nouns than lo SES Mexican-American students. Furthermore, the effect of Grades within Populations was significant, F(4,48) = 3.86. The difference was located primarily in the lo SES Mexican American students, in the Grade 5 vs. Grade 8 contrast, F (1,48) = 9.75, such that Grade 8 students recalled more nouns than Grade 5 students. None of the other Grade contrasts was significant, 8 vs. 11 within lo SES Mexican-American, F(1,48) = 1.44; 5 vs. 8 within mid SES White, F(1,48)= 3.67; 8 vs. 11 within mid SES White, F(1,48) =< 1. The absence of an age difference in the mid SES population is puzzling since Bean and Rohwer (1970) found significant age effects with a 36 items list.

In the analysis of within subjects sources of variance, the effect of Sentence Type was not significant, F (1,48) =< 1. None of

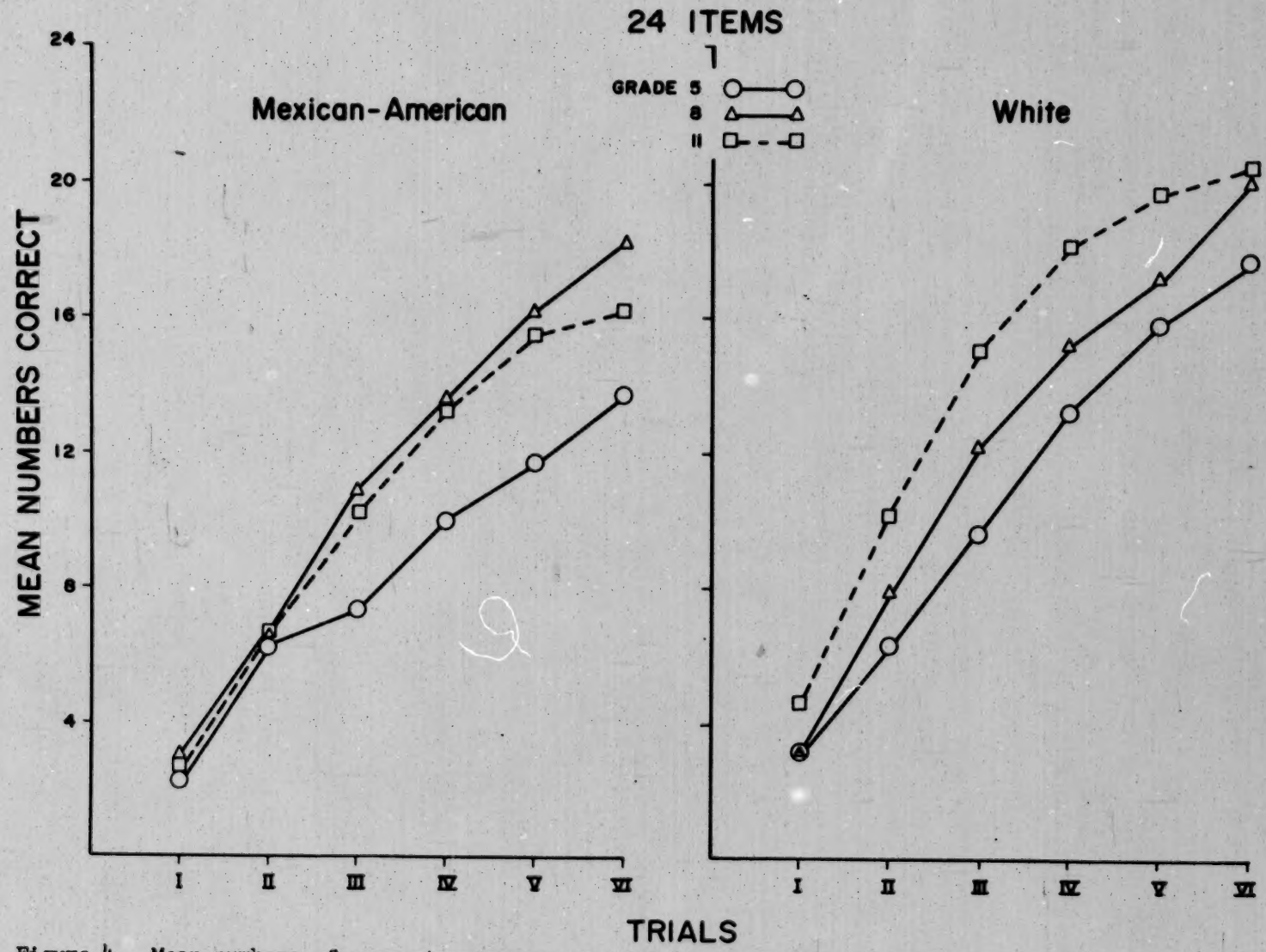

Figure 4. Mean numbers of correct responses per trial as a function of Populations and Grades.

the multivariate tests was significant. However, the linear trend for trials was significant in the contrast, Grade 5 vs. Grade 8 within lo SES Mexican-American, F (1,48) = 10.76. An inspection of Figure 5 reveals that the rate in increase over trials was greater for Grade 8 students than for Grade 5 students.

Insert Figure 5 about here

Correlation coefficents were computed between Peabody raw scores and learning scores. Since there were no consistent patterns to these correlations, the coefficients are presented in Appendix A rather than in the body of this paper.

Discussion

The results of the present study are inconsistent with the past finding that noun pairs are learned faster in NVNCP sentences than in NCNVP sentences. The sentence effect was not replicated in any of the mid SES subjects. Most disturbingly, the sentence effect was glaringly absent in the 5th grade students in the condition most comparable to that used in the previous study by Suzuki (1972), the 24-items condition. An explanation for this finding cannot be provided within the context of this study. There is a strong suggestion, however, that the effects of mixed-lists procedures must be examined more systematically. More specifically, the question that is raised is whether or not similar results would be obtained with a mixed-lists procedure when materials are presented in printed form.

With respect to learning scores collapsed across sentence types, significant differences in performance were observed between lo SES Mexican-American and mid SES White students in the 24 and 36 items lists. An interpretation of this difference would be inappropriate without further replication particularly since previously observed age differences (Bean and Rohwer, 1970) were not observed in the present mid SES sample.

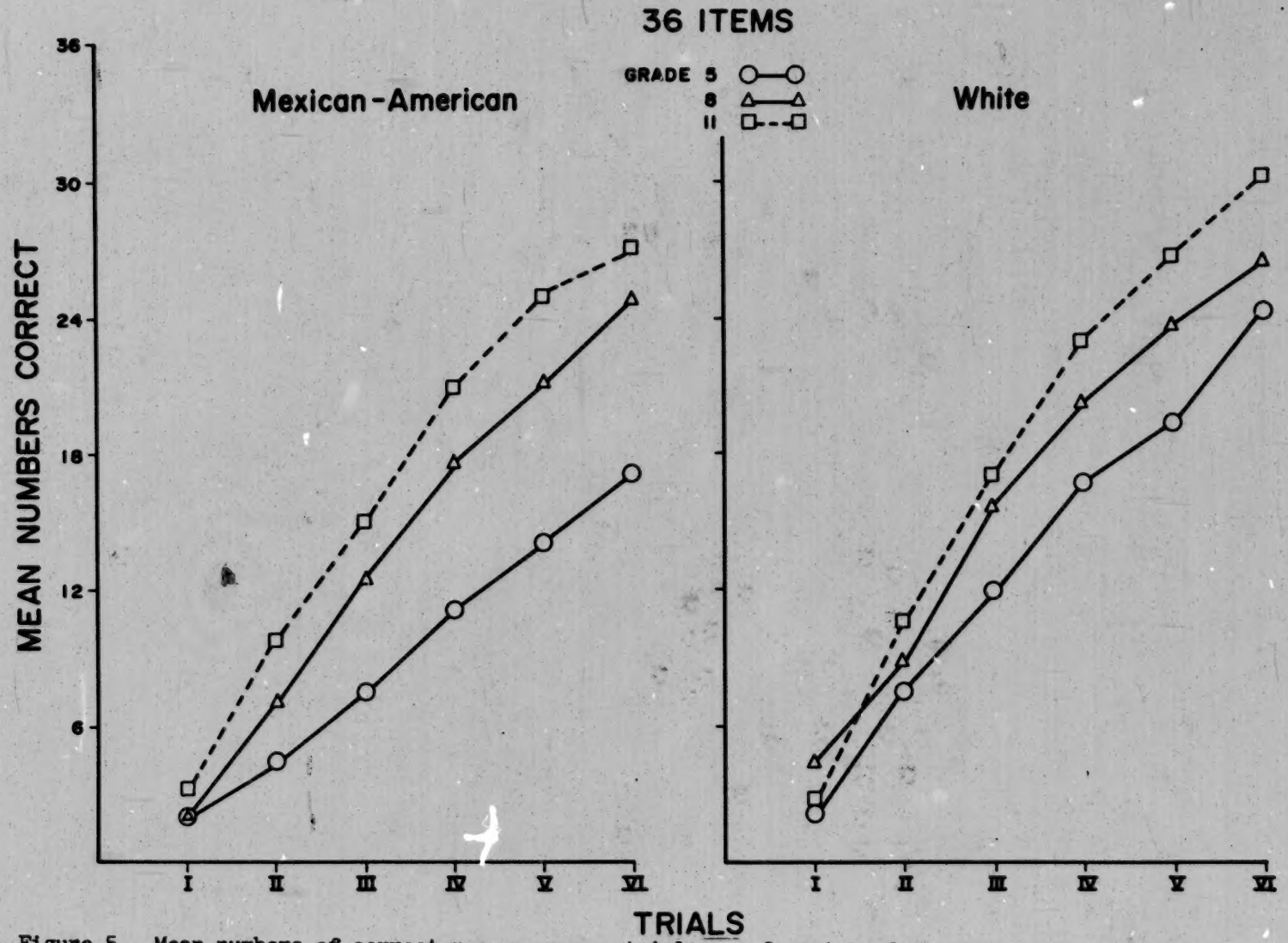

Figure 5. Mean numbers of correct responses per trial as a function of Populations and Grades.

A Developmental Investigation of[3] Aural and Visual Noun-Pair Learning

Nancy S. Suzuki and John E. Oldham

The present study follows directly from Experiment II in the attempt to systematically assess the effects of task and subject variables on the learning of sentence-embedded noun pairs (see Introduction in Experiment II).

Sentence contexts, manipulated within subjects, was found by Levin, Horvitz, and Kaplan (1971) to be associated with performance for aurally presented materials. Sentences presented aurally in a mixed list fashion, however, was not significantly related to performance in Experiment II. One way in which the studies differed was in the nature of the presentation methods. That is, a visual component was included in the aural presentation of the former study, the to-be-learned nouns were presented in printed form along with the aural reading of the sentences. The nouns were not presented in printed form in the latter study. It was, therefore, of interest to examine separately visual and aural aspects of presentation method. It may be that without visually presented printed nouns, a mixed-list presentation of aural items may not produce differences in performance associated with sentence type. The present experiment was designed to assess independently the effects of aural and visual material presentation on the learning of noun pairs in NCNVP and NVNCP sentences.

Another purpose of the present study was to examine the performance of preadolescent as well as adolescent subjects on this task, that is, as a function of variations in sentence context and presentation method. Bean and Rohwer (1970) previously observed differences between preadolescent and adolescent subjects in aural learning. Additionally, they found that the effect of facilitory contexts decreased with increasing age. Similar differences were not observed in Experiment II. The absence of an age difference in Experiment II is puzzling, particularly since preadolescent - adolescent differences have been observed with aural as well as visual presentations in traditional paired-associate learning (Williams, Williams, & Blumberg, 1973).

In sum, the purpose of the present experiment was, (a) to examine the effects of presentation method on sentence-embedded noun-pair learning; (b) to assess age differences within the different presentation methods; and (c) to assess the relationship between age-presentation conditions and sentence type.

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[3]We wish to thank Susann Mongrain for her invaluable assistance in the preparation of materials.

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Method

Materials. The learning materials consisted of 24 pairs of common nouns. Two different lists of 24 noun pairs were used in the present study. The two sentence types were of the form used previously in Experiments I and II. NCNVP sentences were of the form, noun-conjunction-noun-verb-pronoun, and NVNCP sentences were of the form noun-verb-noun-conjunction-pronoun. The following examples illustrate the difference in sentence type,

NCNVP: The belt and the whistle covered it.

NVNCP: The belt covered the whistle and it.

Sentence type was manipulated by means of a mixed-list method. Counterbalancing of item assignment to sentence type resulted in two item sets. Within each set of 24 items NCNVP and NVNCP sentences were randomly ordered and each set included 12 sentences of each type.

Design. The basic design was a 3 x 3 factorial in which the principal factors were Presentation Method (Aural vs. Visual vs. Aural & Visual); and Grade Level (Fifth vs. eighth vs. eleventh). Secondary variables included Sex (males vs. females); List (A vs. B); and Item Set (I vs. II).

Within subject variables were Trials (1-4) and Sentence Type (NCNVP vs. NVNCP). Analysis of within subject variation representing the effects of Trials, Sentence Type and Sentence x Trials was accomplished by means of multivariate analysis of variance.

Presentation method was manipulated in the following manner. In the Aural condition, readings of sentences were presented on auditory casette tapes. In the Visual condition, printed sentences were presented on 5 x 8 cards. Sentences were typed, one per card, in lower case letters except for the first letter in the sentence. The cards were bound together in a looseleaf binder. In the Aural & Visual condition, both the readings of the Aural condition and the printed sentences of the Visual condition were presented. In all three conditions timing was accomplished by prerecorded bell sounds. That is, in both the Aural and Aural & Visual conditions bell sounds were recorded in with the readings. For the Visual condition bell sounds were recorded on an otherwise blank tape to signal appropriate timing intervals. All materials were presented at a 4-sec. rate.

Subjects. One hundred and forty four students participated in the present study. Forty eight students from each of the three grade levels were randomly assigned to the experimental conditions. All three public schools serve a middle class residential area in North Vancouver, B. C., and schools were selected such that the elementary school graduates continue on to the two secondary school. Equal numbers of male and female students participated.

Procedure. The task was administered individually by a study-test method for a total of 4 trials. A white male experimenter asked the subjects to listen to/read the sentences and attempt to memorize the two nouns from each sentence such that when one of the nouns from each sentence was presented they could supply the missing noun from that sentence. Four example items were presented and repeated until subjects recalled three out of four items correctly.

All of the materials were presented successively at a 4-sec. rate during study and test trials. The intertrial interval was 4-sec. After the learning task was administered the Peabody Picture Vocabulary Test (Form B) was administered to the subjects.

Results

The mean numbers of correct responses is presented in Table 3 as a function of Grades, Presentation Method, and Sentence Type.

Insert Table 3 about here

A preliminary multivariate analysis of variance including List and Item Set as factors revealed that neither the main effects of either List or Item Set, F (8,65)=<1, and F (8,65) = 1.10, respectively, nor any of their interactions were significant at the .01 level. Lists and Item Sets were therefore pooled in the final analysis. The dependent variable for the between subjects sources of variance was the total number of correct responses across 4 trials and 2 sentence types. The between sources of variance were tested with the probability of a Type I error at .05. Multivariate tests and within univariate tests were tested at .01.

The main effect of Presentation Method was not significant, F (2,126) =<1. However, Grades within Presentation Method was significant, F (6,126) = 3.62. The tests for the nonorthogonal grade contrasts revealed a significant difference for the Grade 5 vs. Grade 8 contrast in both the Aural condition, F (1,126) = 7.55, and the Visual condition, F (1,126) = 9.02. Neither one of the age contrasts in the Aural & Visual condition was significant. Sex within conditions was not significant, F(3,126) =<1. The interaction of Grades x Sex within conditions was also not significant, F (6,126)=<1.

For the analysis of the within subjects sources of variance 7 orthogonal linear transformations were created from the original 8 variates of Trials and Sentence Type. The overall effect of Sentence Type was not significant, F (1,126) =<1. Trials, however, was significant, F (3,378)= 701.17. Performance is displayed graphically in Figure 6 as a function of Presentation Method, Grades, and Trials.

Table 3

Mean Numbers of Correct Responses per Trial as a Function of Grades, Sentence Type, and Presentation Method

Presentation Method	Grade 5			Grade 8			Grade 11		
	NCNVP	NVNCP	Total	NCNVP	NVNCP	Total	NCNVP	NVNCP	Total
Aural	3.56	3.16	3.36	4.66	4.44	4.55	5.50	5.77	5.63
Visual	3.28	4.11	3.69	5.73	5.72	5.73	5.53	5.36	5.44
Aural & Visual	4.05	4.03	4.04	4.52	4.77	4.64	5.44	5.06	5.25

Note.--Maximum possible = 12

Insert Figure 6 about here

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The effect of Presentation Method was not significant, $F(16,238) < 1$. However, both of the age contrasts within the Aural condition were significant, Grade 5 vs. Grade 8, $F(8,119) = 3.24$; Grade 8 vs. Grade 11, $F(8,119) = 2.93$. Univariate tests revealed that the groups differed in linear trends in both age comparisons, 5 vs. 8, $F(1,126) = 15.70$, and 8 vs. 11, $F(1,126) = 14.91$. An inspection of Figure 6 reveals that the rate of increase over trials is greater with increasing age. This finding is consistent with previous findings of age differences (Bean & Rohwer, 1970; Williams, J., Williams, D. V., & Blumberg, E. L, 1973)with aurally presented items.

The sentence variable approached significance only in the Grade 5 vs. Grade 8 contrast within the visual condition, $F(1,126) = 3.42$, $p < .06$. An inspection of Table 1 reveals that the means for Grade 5 students were in the expected direction while there was virtually no difference for Grade 8 students. The Sentence Type x Quadratic contrast was significant for Grade 8 vs. Grade 11 within Visual, $F(1,126) = 8.68$. An inspection of the means suggested that Grade 11 NVNCP differed from the other trends and took a quadratic form. None of the effects of Sex within conditions was significant. None of the Grade x Sex within conditions effects were significant except the contrast, Grade 8 vs. Grade 11 by Sex within the Aural & Visual condition, $F(8,119) = 2.58$. The univariate test for a cubic trend was significant, $F(1,126) = 8.00$. This contrast is displayed graphically in Figure 7. An inspection of the learning curves for

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Insert Figure 7 about here

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the four groups suggests that the difference was located between the 11th grade females and the other three groups. The reason for this difference remains indeterminate.

Correlation coefficients were computed between Peabody raw scores and learning scores. Since there were no consistent patterns to these correlations, the coefficients are presented in Appendix A rather than in the body of the paper.

Summary

The results of the present study are consistent with the previous findings of age differences between preadolescent and adolescent subjects for both aurally presented and visually presented materials(Bean & Rohwer, 1970; Williams, Williams, & Blumberg, 1973). Although the effect of sentence type was in the expected direction for fifth graders in the visual condition, the difference was not statistically significant.

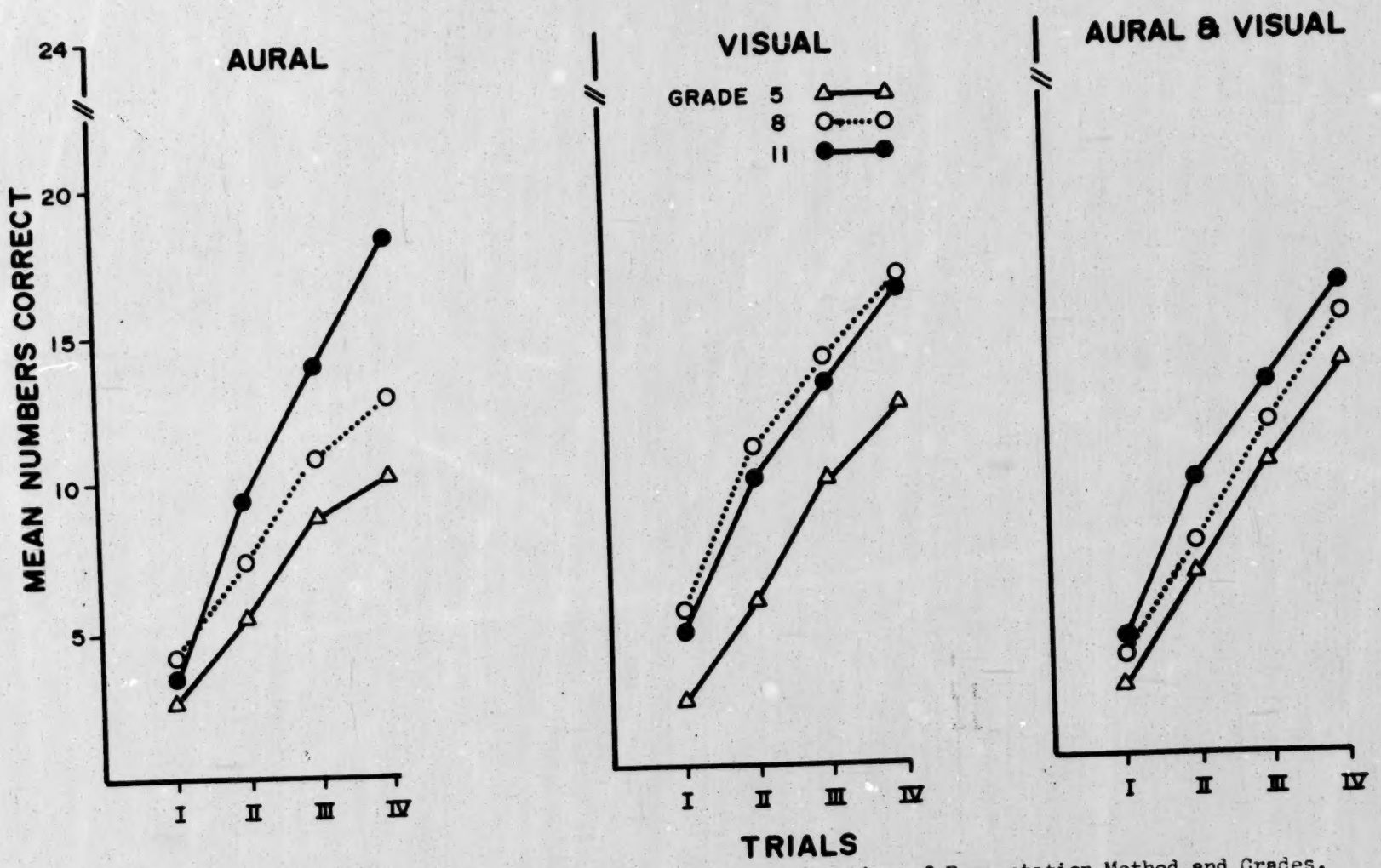

Figure 6. Mean numbers of correct responses per trial as a function of Presentation Method and Grades.

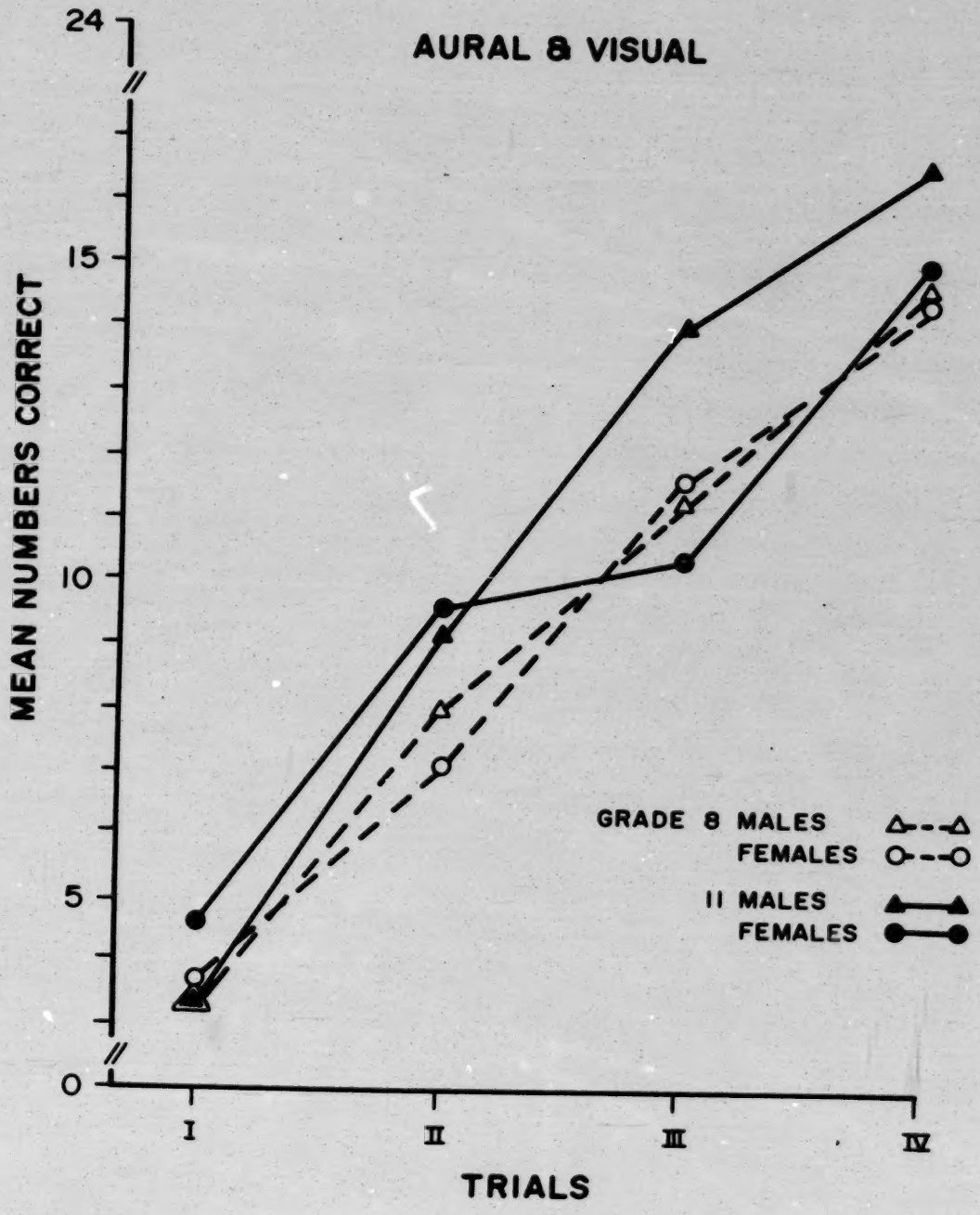

Figure 7. Mean Numbers of correct responses per trial as a function of Grade and Sex.

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Appendix A

Experiment #1

	Lo SES			Mid SES		
	List I	List II	List III	List I	List II	List III
CC	.38	.36	.09	.21	.43*	.34
VV	-.01	-.03	.01	.31	.25	.09

Experiment #2

		12 Items	24 Items	36 Items
Lo SES Mexican-American	Grade 5	.44	.72**	.14
	8	.33	.69*	.28
	11	.70*	.26	.63*
Mid SES White	Grade 5	.67*	.56	.39
	8	.69*	.24	.68*
	11	.12	.37	.45

Experiment #3

	Aural	Visual	Aural & Visual
Grade 5	.25	-.07	.37
Grade 8	.34	.44	.60*
Grade 11	.01	.17	-.14

* $p < .05$
** $p < .01$

Appendix B

Example List of Items

The toothpick_____the comb_____her.	scraped, and
The picture_____the ribbon _____this.	hid, and
The candy_____the pig_____them.	soiled, and
The jail_____the gorilla_____him.	trapped, and
The soup_____the dirt_____this.	covered, and
The tractor_____the brick_____it.	crumbled, and
The bracelet_____the paper_____this.	lay on, and
The snake_____the book_____this.	rested on, and
The feather_____the guitar_____it.	touched, and
The beard_____the donkey_____him.	tickled, and
The rabbit_____the dollar_____this.	landed on, and
The boot_____the crab_____this.	smashed, and
The bee_____the clock_____this.	sat on, and
The snowman_____the ladder_____him.	fell on, and
The flag_____the ax_____it.	brushed against,and
The cow _____the ball_____her.	stopped, and
The string_____the spider_____it.	dangled over, and
The pencil_____the cigarette_____this.	marked, and
The teacher_____the wheel_____him.	moved, and
The needle_____the bucket_____this.	dropped into, and
The bat_____the cup_____her.	hit, and
The rope_____the eraser_____it.	rubbed, and
The crow_____the stick_____him.	scratched, and
The gum_____the eyelash_____her.	stuck to, and